cal America from which herbaria, both in England and on the Continent, have been more bountifully supplied. The consequence is, that out of this 180 we do not think that more than from twelve to twenty species are really new, in any sense in which we understand in this country what is meant by a species. For instance, we have some seven or eight species elaborately characterised and figured from what cannot be called anything else than so many individual fronds of that most cosmopolitan of ferns, our common English *Aspidium* or *Polystichum aculeatum*. Or, to take one of the exclusively Brazilian species, *Cyathea Gardneri*, a very distinct tree-fern, is included in the list under five different names—*Gardneri* (Dr. Gardner's number on which Hooker described the species quoted), *incurvata* (a name of Kunze's published in the Linnæa from Regnell's specimens), *mamillata*, *taunaysiana* and *attenuata*, the last three new species here named and figured for the first time; but the figures, beautiful as they are, might, any of them, have been drawn from Gardner's specimens. The author does not seem to have any knowledge of numerous English and German books and papers in which Tropical American ferns are described, as for instance, Grisebach's excellent Flora of the British West Indies; and this leads to further name-crossing. In short, although one cannot but admire the excellence and the copiousness of the illustrations in these memoirs, and ought not to leave out of sight the example of devotedness to science which they show, expenditure of time devoted to one object through a long course of years, and of money, only a very small proportion of which their sale can possibly repay, yet still the predominant feeling on the mind must needs be that to deal with plants in this way has a direct tendency to bring species-botany at a very rapid rate into a state of utter confusion.

J. G. BAKER

The Laboratory Guide. A Manual of Practical Chemistry for Colleges and Schools, especially arranged for Agricultural Students. By A. H. Church, M.A., Professor of Chemistry in the Royal Agricultural College, Cirencester. Second edition, enlarged and revised, pp. 170. (London: Van Voorst, 1870.)

THIS little book, as its title indicates, is intended mainly for the use of students of agricultural chemistry, and we fear it might cause disappointment to anyone who wished to employ it as a guide to general analysis. The science of chemistry is so rapidly increasing, that it would seem almost hopeless, at the present time, to give students a complete knowledge of chemistry and leave them to apply their information to the special subject they intend to follow. Professor Church's book is intended to obviate this difficulty, and after a few introductory lessons of universal application, the student commences experiments on materials with which he is certain to come in contact in agriculture, such as superphosphate, milk, soils, &c. Part I. treats of chemical manipulation, and consists of a number of lessons intended to accompany the course of lectures, and from which the student will learn the mode of performing some simple operations, as solution, filtration, crystallisation, specific gravity, and will become acquainted with the modes of preparation and properties of the principal elements and compounds. Each lesson commences with a list of the apparatus required, the ordinary reagents, and the special materials and tests necessary for the performance of the experiments, which are detailed with great clearness. This arrangement is calculated to cause the student to be careful to have everything ready before commencing work, and will thus save him much time and inconvenience, for few things are more likely to endanger the success of an experiment than leaving it at a critical moment in order to obtain some piece of apparatus or reagent which should have been previously prepared. Part II. treats of qualitative analysis, of which Chapter I. deals with the elements, reagents and tests, and reactions; and here we find the terms univinculant, bivinculant, trivinculant, &c., as equivalent to monad, dyad, triad, &c. The principal distinguishing characteristics of the different groups of elements are here given. The section on reagents and tests will be found useful, for it contains the modes of testing for impurities, and indicates the strength of the different solutions employed, two things to which attention should always be paid. The second chapter of this part describes the methods of qualitative analysis, all rare elements and those with which the agricultural student is not likely to meet being omitted. The third part is devoted to the general processes of quantitative analysis, and the fourth to the examination of manures, soils, water, and food. This book will doubtless be invaluable to agricultural students, besides being useful to those requiring special information on the subjects of which it treats. The appearance of such a work is a satisfactory indication of the extension of the application of scientific chemistry to the useful arts.

The Book of the Roach. By Greville Fennell (of the *Field*). 16mo. pp. 118. (London: Longmans and Co. 1870.)

WHILST Mr. Pennell has instructed us in catching *lege artis* all the various fish in British rivers and lakes, Mr. Fennell has been content to devote a little volume to the natural history and fishing of the Roach. Let no one smile at the man in the punt with his humble notions of enjoyment. Maybe he has been toiling hard the whole week in the noisy, murky town; the quiet sport of the Saturday afternoon suits his purse exactly, and there will be real enjoyment over the dish of fried roach "caught by father." Nay, if we could measure the amount of pleasure, healthy recreation, and renewal of vigour obtained by the multitude in the unpretentious sport of roach-fishing, and compare it with that sought for by the select few who have the privilege of finding their amusement on a salmon river, we should probably find the balance very much on the side of the former. No apology, therefore, was needed from Mr. Fennell for the publication of his little book on the Roach. He has divided it into eight chapters, of which the first two are devoted to the natural history of this fish, and the five following to a description of the tackle and various kinds of baits, and to the methods of roach-fishing generally as well as at certain localities. In the last chapter hints are given on the roach as an article of food, on the method of cooking, &c.

A. G.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his Correspondents. No notice is taken of anonymous communications.*]

Hypothesis regarding the Corona

HAVING read in Nos. 34 and 35 of the valuable periodical NATURE (of June 23 and 30) the two articles about the Corona, I beg leave to direct your attention to an hypothesis concerning its nature, and especially the origin of the *beams*, which I sent to the Physical section of the Amsterdam Academy of Sciences, of which I have the honour to be a member.

I have just received No. 1776 of the *Astronomische Nachrichten*, for October 15, where the American astronomer, Dr. Gould, in a notice regarding the total eclipse of the sun of August 7 (1869) says:—

"Of the Corona I made some hasty measurements both with the telescope and without it. Its form varied continually, and I obtained drawings for three epochs at intervals of a minute. It was very irregular in form, and in no apparent relation with the protuberances of the sun, or the position of the moon. Indeed, there were many phenomena which would almost lead to the belief that it was an atmospheric rather than a cosmical phenomenon. One of the beams was at least 30′ long."

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This passage induced me to submit to the trial and judgment of my fellow-members of the Physical section of the Royal Academy a very simple hypothesis regarding the nature of the Corona, which entered my mind shortly after the observation of the total eclipse of August 18, 1868.*

I think—and, if I am not mistaken, all astronomers agree with me—that a part of the luminous phenomenon which we call the Corona belongs to an atmosphere of the sun,† having a feeble reflecting power, or being itself luminous. But the beams in the Corona, whose variability is now confirmed anew, are necessarily an optical phenomenon. They originate, I believe, in the inequalities of the moon's surface. If the sunlight slants somewhere along the moon's limb through a *valley*, we observe from our point of view a *beam*, provided there exist between the moon and us particles able to reflect the sunlight, or to transmit it like semi-transparent bodies. There is no need to have recourse to diffraction.

To look for these particles in the atmosphere of the earth, as Mr. Gould does, is, in my opinion, not tenable, as the Corona and the beams have also been observed in eclipses, where the cone of the shadow even had‡ a breadth of thirty-six German leagues. The molecules of the atmosphere, which we see around the eclipsed sun, are wholly within the cone of the shadow.

These reflecting particles are undoubtedly to be looked for beyond our atmosphere, between the moon and the earth, and I believe that they may be regarded as identical with those particles which float in the ether, and under other circumstances cause the zodiacal light.

That the zodiacal light, or rather the particles which cause it, reach the earth's orbit, is, as regards nearly its whole circumference, not subject to any doubt, as the apex of the zodiacal light is "mostly farther off the sun than 90°. Only in the months of March and April is it not possible to follow the zodiacal light so far" (Schmidt, "Das Zodiacallicht," Braunschweig, 1856). But then, at those particles which are situated on the apex of the zodiacal light, the sun's ray makes a right angle with the line which joins the earth, and the circumstances are not favourable for small and widely-dispersed particles to reflect much sunlight in the direction of the earth. It is, therefore, probable that in March and April these particles would show themselves farther from the sun if the illumination were stronger. At a total eclipse of the sun that angle is 179¼° for a particle visible at 30′ distance from the moon's limb, and 179¾° for particles in the immediate neighbourhood of the moon's limb; and it is an acknowledged fact that, under these circumstances, there is much more light reflected than if reflected at a right angle. Moreover, the intensity of the transmitted light increases equally with this angle.

Schmidt mentions, in his above-quoted work, that he and other observers, during the total eclipse of July 28, 1857, looked out for the zodiacal light, but in vain. He thought the sky not dark enough, and expresses himself as follows:—"Das Ansehen der den schwarzen Mond umgebenden vielstrahligen Corona war im ganzen betrachtet nicht gerade geeignet, sie *sogleich* in Beziehung zum Zodiacallichte zu denken."

Thus it seems that the beams made Schmidt conclude, "This is no zodiacal light." If my explanation is the true one, and if the sun's atmosphere is accepted as unlimited, and gradually passing over into the ether, then the light of the Corona, which equally surrounds the moon, falls altogether into the same category as the beams, only that it originates in the reflecting particles beyond the moon. Accordingly, my hypothesis is expressed thus: *Both the Corona and its beams have the same origin as the zodiacal light.*

I remark, finally, that the strangely curved form of some beams, as well as their variability, may be very well accounted for on this hypothesis—the curved form by the irregularity of the moon's surface. For instance: I take a particle of light of a beam of the Corona; I imagine myself in the molecule which, according to my hypothesis, corresponds with that particle of light, and which is situated between the moon and my eye. Looking, then, from that stand-point to the moon, I must see the light of the sun slanting over a valley; but if I move myself laterally—*i.e.* in the direction parallel to the moon's radius which corresponds with that valley—then it is not certain that I shall see on the same point an extraordinary amount of light, for it is possible that at the same place a ridge has intervened. It is, however, very possible that, if I move in a direction perpendicular to the former (and also perpendicular to the direction towards the earth), I come into a region where that ridge does not intervene, but where the continuation of the valley is again visible, through which the sunlight slants. In this case, the beam of the Corona—*i.e.* the effect produced by those particles which receive more light than others at equal distances from the surface of the cone, having its apex in the eye, and which surrounds the moon—has a curved form.

The variability is, I think, satisfactorily explained by the motion of the moon passing by the sun.

This hypothesis forced itself upon me when at Toli-holi* I saw the moon rising behind a hill. Before she made her appearance her light shone over the trees, and produced, in a hazy air on my side of the hill, beams which very much resembled those of the Corona. I do not know whether the zodiacal light has already been analysed by the spectroscope; if so, the comparison of the spectra of zodiacal light and the Corona will serve to test my hypothesis.

A second test is this: total eclipses observed in the months of December and January should show less brilliant beams than total eclipses observed in other months, since in December and January the earth is near the direction of the perihelion of the circumference of the zodiacal light. The next total eclipse of December 12, 1871, will perhaps give some information on this point.† J. A. C. OUDEMANS

Batavia, Sept. 2

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* At the Island of Mantawalu-kéké (near Celebes), where I had the pleasure of meeting the Commander (Captain Bullock) and the Etat-Major of H.M.S. *Serpent*, and the Spanish astronomers of the municipal Athenæum at Manilla, the fathers Faum, Nonnell, and Ricardo.

† This is probably the Chromosphere, as seen in the Eclipse.—ED.

‡ (*Subintellige*): at the surface of the earth.

* *Vulgo*, erroneously, Tontoli, north coast of Celebes.

† We hope also something from next month's eclipse.—ED.

The Fuel of the Sun

IN your impression of October 6 Mr. Murphy adds another to the frequent attempts that are still made to galvanise the expiring hypothesis that attributes the solar heat and light to a meteoric bombardment. Many very strong and sufficient objections have been already brought against it, but as Mr. Murphy states that he is "not mathematician enough to form any opinion on the merits of the controversy," I will add two arguments which to my mind are quite sufficient to annihilate this explanation—both of which may be sufficiently understood without mathematics, and neither of which have I ever seen fairly stated.

1st. The advocates of the meteoric bombardment usually start from the fact that great meteoric showers fall upon the earth. Thus, Dr. Tyndall, in his lectures on "Heat considered as a Mode of Motion," introduces Mayer's hypotheses, with an account of the number of meteors counted during the August and November showers; and these observed meteors and a few comets are the only actual observed material upon which this bombardment theory rests—all beyond them are mere figments of mathematical imagination, and any supplies derived from the zodiacal light, or otherwise exclusively from the space within the earth's orbit, must have been exhausted within the period of human existence.

Now, it is quite obvious, without any detailed calculation, that if these meteoric bodies, coming from anywhere you please outside of the earth's orbit in sufficient quantities to maintain the heat and light of the sun, had fallen, as they must have done, upon the earth in a proportion due to its magnitude and position, they must in the course of a few millions of years—say from the era of the Laurentian rocks to that of the London sewage deposits—have covered the earth with a very important superficial stratum, instead of merely supplying a few rare specimens for our museums. Every slowly deposited sedimentary rock upon the face of the earth should be thickly peppered and conglomerated with meteoric dust and nodules. With these considerations and the well-known geological facts before us, I need scarcely state the obvious conclusion, viz. that the evidences in support of the theoretical terrestrial requirements of this bombardment hypothesis are contemptibly insufficient.

My second objection attacks the fundamental basis of this hypothesis, and I think destroys it altogether. I maintain that any explanation of the sources of solar light and heat which does not equally and necessarily account for the radiations of all the other self-luminous orbs that people the whole immeasurable depths of space, is philosophically worthless. It is thus worthless if it does not also account for the perpetual renewal, the constancy, the eternal permanence, of all these radiations. The pale nebulæ, as well as the brighter suns, should be equally included in its grasp.

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